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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
PERILLA, JASON M	
ART UNIT	**PAPER NUMBER**
2634	

DATE MAILED: 12/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/667,651	POOR ET AL.	
	Examiner	Art Unit	
	Jason M Perilla	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 September 2000.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-24 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-24 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 22 September 2000 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. Claims 1-24 are pending in the instant application.

Priority

2. Applicant's claim for domestic priority under 35 U.S.C. 119(e) is acknowledged.

Drawings

3. This application lacks formal drawings. The informal drawings filed in this application are acceptable for examination purposes. When the application is allowed, applicant will be required to submit new formal drawings.

Specification

4. This application does not contain an abstract of the disclosure as required by 37 CFR 1.72(b). An abstract on a separate sheet is required.

Claim Objections

5. Claim 20 is objected to because of the following informalities:

Regarding claim 20, on line 5 the words "said until" should be replaced with –until said-.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 10-12 and 22-24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 10, the beam scheduling sequence is claimed to be generated by the solution to the equation on line 5. However, the parameters and arguments of the equation set forth on line 5 are not properly defined. Hence, claim 10 is found to be indefinite because one skilled in the art is unable to determine the meaning of the terms in the equations on line 5 by the claim alone. To clearly claim generating a solution using the equation on line 5, all of the terms and arguments of the equation must be defined in the claim. Any notation used that is not common to one of ordinary skill in the art must also be defined so that one can understand the meaning of the claim without reference to the specification.

Regarding claim 11, the term $P_{G-1|G-1}(F_{G-1})$ is not defined in the claim, and it is not understood by one of ordinary skill in the art within the content of the claim. All mathematical arguments used in claims should be clearly defined so that one of ordinary skill in the art is able to define them by reading the claim. Claim 11 is found to be indefinite because the meaning of $P_{G-1|G-1}(F_{G-1})$ is not clearly defined.

Regarding claim 12, all mathematical arguments and notation used in claims should be clearly defined so that one of ordinary skill in the art is able to define them by reading the claim. Claim 12 is found to be indefinite because the equations on lines 3-5 of the claim use arguments that are not commonly understood or clearly defined to one of ordinary skill in the art.

Regarding claim 22, the beam scheduling sequence is claimed to be generated by the solution to the equation on line 4. However, the parameters and arguments of the equation set forth on line 4 are not properly defined. Hence, claim 22 is found to be

indefinite because one skilled in the art is unable to determine the meaning of the terms in the equations on line 4 by the claim alone. To clearly claim generating a solution using the equation on line 4, all of the terms and arguments of the equation must be defined in the claim. Any notation used that is not common to one of ordinary skill in the art must also be defined so that one can understand the meaning of the claim without reference to the specification.

Regarding claim 23, the term $P_{G-1|G-1}(F_{G-1})$ is not defined in the claim, and it is not understood by one of ordinary skill in the art within the content of the claim. All mathematical arguments used in claims should be clearly defined so that one of ordinary skill in the art is able to define them by reading the claim. Claim 23 is found to be indefinite because the meaning of $P_{G-1|G-1}(F_{G-1})$ is not clearly defined.

Regarding claim 24, all mathematical arguments and notation used in claims should be clearly defined so that one of ordinary skill in the art is able to define them by reading the claim. Claim 24 is found to be indefinite because the equations on lines 3-5 of the claim use arguments that are not commonly understood or clearly defined to one of ordinary skill in the art.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1-2, and 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted the prior art as shown in figure 1 in view of Nowak (5903826).

Regarding claim 1, the admitted prior art according to figure 1 discloses an apparatus for performing beamforming on a plurality of signals in a reception channel received from a receiving antenna array (pgs. 2-7, "background of the invention"; ref. 12) the signals including simultaneous data signals from a plurality of transmitters, a frequency downconverting circuit (ref. 16) for converting the beam signal to baseband, and a multi-path/multi-user estimation circuit for generating path estimates and path estimate errors for each of the multiple simultaneous transmitters from the baseband beam signal (ref. 20). The admitted prior art as discloses the common use of a beamforming antenna array (refs. 12, 14). The admitted prior art does not disclose an Nx1 switched beam beamforming circuit for weighting and combining outputs of N antenna receiving elements and generating a single beam therefrom based on a beam scheduling sequence or a beam schedule generating circuit for generating the beam scheduling sequence for switching between ones of a plurality of beams for generation by the beamforming circuit. However, Nowak does teach an Nx1 switched beam beamforming circuit for weighting and combining outputs of N antenna receiving elements and generating a single beam therefrom based on a beam scheduling sequence (col. 3, lines 61-66; fig. 2, ref. 28) and a beam schedule generating circuit for generating the beam scheduling sequence for switching between ones of a plurality of beams for generation by the beamforming circuit (col. 1, lines 55-60; col. 3, lines 59-61;

fig. 2, ref. 26). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the Nx1 switched beam beamforming circuit and beam scheduling circuit as taught by Nowak in the admitted prior art system as shown in figure 1 because by using the Nx1 beamforming switch and beamforming sequence circuit as taught by Nowak, the admitted prior art system could be simplified to contain fewer circuits as is obvious to one having ordinary skill in the art.

Regarding claim 2, the admitted prior art as shown in figure 2 further shows an analog-to-digital converter (ref. 18) between the frequency downconverting circuit and the multi-path/multi-user estimation circuit wherein the multi-path/multi-user estimation circuit comprises a digital signal processor (pg. 5, lines 21-26).

Regarding claim 13, the admitted prior art as shown in figure 1 discloses a method for performing beamforming on a plurality of signals in a reception channel received from a receiving antenna array including simultaneous data signals from a plurality of transmitters comprising, receiving the outputs of N antenna and converting beam signal to baseband (fig. 1, ref. 16), and generating path estimates and path estimate errors for each of the multiple simultaneous transmitters from the baseband beam signal (fig. 1, ref. 20). The admitted prior art does not disclose weighting and combining the outputs of the N antenna receiving elements and generating a single beam therefrom based on a beam scheduling sequence and generating a beam scheduling sequence for switching between ones of a plurality of beams for generation by the beamforming circuit. However, Nowak does teach an Nx1 switched beam beamforming circuit for weighting and combining outputs of N antenna receiving

elements and generating a single beam therefrom based on a beam scheduling sequence (col. 3, lines 61-66; fig. 2, ref. 28) and a beam schedule generating circuit for generating the beam scheduling sequence for switching between ones of a plurality of beams for generation by the beamforming circuit (col. 1, lines 55-60; col. 3, lines 59-61; fig. 2, ref. 26). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the Nx1 switched beam beamforming circuit and beam scheduling circuit as taught by Nowak in the admitted prior art system as shown in figure 1 because by using the Nx1 beamforming switch and beamforming sequence circuit as taught by Nowak, the admitted prior art system could be simplified to contain fewer circuits as is obvious to one having ordinary skill in the art. Therefore, the admitted prior art in view of Nowak discloses a method for performing beamforming on a plurality of signals in a reception channel received from a receiving antenna array, the signals including simultaneous data signals from a plurality of transmitters, the method comprising the steps of: (1) weighting and combining outputs of N antenna receiving elements and generating a single beam therefrom based on a beam scheduling sequence, wherein N is an integer greater than 1; (2) generating the beam scheduling sequence for switching between ones of a plurality of beams for generation by the beamforming circuit; (3) converting the beam signal to baseband; and (4) generating path estimates and path estimate errors for each of the multiple simultaneous transmitters from the baseband beam signal.

Regarding claim 14, the admitted prior art as shown in figure 2 further shows an analog-to-digital converter (ref. 18) between the frequency downconverting circuit (3) and the multi-path/multi-user estimation circuit (4).

10. Claims 3-9, and 15-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted the prior art as shown in figure 1 in view of Nowak as applied to claim 2 above, and in further view of Chang et al (Communications, 1999. ICC '99. 1999 IEEE International Conference on; page(s): 1588-1592 vol. 3)

Regarding claim 3, the prior art in view of Nowak describes the limitations of claim 2 as applied above. However, the prior art in view of Nowak does not disclose that the schedule generating circuit is adapted to generate the beam scheduling sequence by determining a minimum mean square error estimation of a state-space model of the reception channel. However, Chang et al teach the use of least mean square (LMS) or minimum mean squared error, normalized least mean square error (NLMS), and recursive least square (RLS) methods for adaptive beamforming (pg. 1590, col. 1, lines 35-40). The use of a minimum mean squared error estimation of a state-space model of the reception channel is commonly known in the art because it leads to correct symbol decisions. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the minimum mean squared estimation of a state space model of the reception channel as taught by Chang et al in the beamforming system as disclosed by the admitted prior art in view of Nowak because it would provide for better symbol decisions even when interference is found in the receiving channel.

Regarding claim 4, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 3 as applied above. Further Chang et al discloses switching the selected antenna beam at a rate faster than a data rate of the signals in the reception channel. Chang et al discloses chip-level beamforming (pg. 1588, col. 2, lines 17-20) meaning that the antenna are switched on a chip by chip basis. One skilled in the art understands that the chip rate is sufficiently faster than the data rate. Because Chang et al discloses switching the antenna at the chip rate, this leads to the beam schedule generating circuit switching at the chip rate.

Regarding claim 5, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 3 as applied above. The admitted prior art in view of both Nowak and Change et al disclose that the beamforming apparatus is configured to receive a spread spectrum signal. Nowak notes the reception of code division multiple access (CDMA) signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction. It is well known to one skilled in the art that a CDMA signal is a direct sequence spread spectrum signal having a chip rate. Further, Chang et al discloses chip-level beamforming (col. 2, lines 17-20) meaning that the antenna are switched on a chip by chip basis. Because Chang et al discloses switching the antenna at the chip rate, this leads to the beam schedule generating circuit switching at the chip rate.

Regarding claim 6, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 5 as applied above. Further, Nowak and Change et al disclose that the beamforming apparatus is configured to receive a spread

spectrum signal. Nowak notes the reception of CDMA signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction.

Regarding claim 7, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 6 as applied above. Further, Nowak and Change et al disclose that the beamforming apparatus is configured to receive a spread spectrum signal. Nowak notes the reception of CDMA signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction. It is well known in the art that CDMA signals are direct sequence spread spectrum (DSSS) modulated signals. Chang et al discloses that the CDMA signals are DS-CDMA signals (pg. 1591, col. 2, line 13) or direct sequence CDMA signals.

Regarding claim 8, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 4 as applied above. Further Nowak discloses that the beam schedule generating circuit revises the beam scheduling sequence at predetermined intervals until revised (col. 5, lines 13-16).

Regarding claim 9, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 8 as applied above. Further Nowak discloses a memory (fig. 2, ref. 38) and wherein the beam schedule generating circuit stores each beam scheduling sequence in the memory and retrieves the beam scheduling sequence from the memory to be used for controlling the beamforming circuit during the interval of its use (col. 5, lines 10-16).

Regarding claim 15, the prior art in view of Nowak describes the limitations of claim 14 as applied above. However, the prior art in view of Nowak does not disclose

that step (2) above generates the beam scheduling sequence by determining a minimum mean square error estimation of a state-space model of the reception channel. However, Chang et al teach the use of least mean square (LMS) or minimum mean squared error, normalized least mean square error (NLMS), and recursive least square (RLS) methods for adaptive beamforming (pg. 1590, col. 1, lines 35-40). The use of a minimum mean squared error estimation of a state-space model of the reception channel is commonly known in the art because it leads to correct symbol decisions. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the minimum mean squared estimation of a state space model of the reception channel as taught by Chang et al in the beamforming system as disclosed by the admitted prior art in view of Nowak because it would provide for better symbol decisions even when interference is found in the receiving channel.

Regarding claim 16, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 15 as applied above. Further Chang et al discloses the method of step (2) above wherein the selected beam rate is switched at a rate faster than a data rate of the signals in the reception channel. Chang et al discloses chip-level beamforming (pg. 1588, col. 2, lines 17-20) meaning that the antenna are switched on a chip by chip basis. One skilled in the art understands that the chip rate is sufficiently faster than the data rate. Because Chang et al discloses switching the antenna at the chip rate, this leads to the beam schedule generating circuit switching at the chip rate.

Regarding claim 17, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 15 as applied above. The admitted prior art in view of both Nowak and Change et al disclose that the beamforming apparatus is configured to receive a spread spectrum signal. Nowak notes the reception of code division multiple access (CDMA) signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction. It is well known to one skilled in the art that a CDMA signal is a direct sequence spread spectrum signal having a chip rate. Further, Chang et al discloses chip-level beamforming (col. 2, lines 17-20) meaning that the antenna are switched on a chip by chip basis. Because Chang et al discloses switching the antenna at the chip rate, this leads to step (2) above wherein step (2) comprises switching the selected beam at the chip rate.

Regarding claim 18, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 17 as applied above. Further, Nowak and Chang et al disclose that the beamforming method is configured to receive a spread spectrum signal. Nowak notes the reception of CDMA signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction.

Regarding claim 19, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 18 as applied above. Further, Nowak and Change et al disclose that the beamforming method is configured to receive a spread spectrum signal. Nowak notes the reception of CDMA signals (col. 7, line 40) and Chang et al discloses CDMA reception as well in the introduction. It is well known in the art that CDMA signals are direct sequence spread spectrum (DSSS) modulated signals.

Chang et al discloses that the CDMA signals are DS-CDMA signals (pg. 1591, col. 2, line 13) or direct sequence CDMA signals.

Regarding claim 20, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 16 as applied above. Further Nowak discloses that the method of step (2) above comprises (2.1) the revising of the beam scheduling sequence at predetermined intervals (col. 5, lines 13-16), and (2.2) using each given beam scheduling sequence repetitively until the beam scheduling sequence is revised (col. 5, lines 10-16).

Regarding claim 21, the admitted prior art in view of Nowak and in further view of Chang et al discloses the limitations of claim 20 as applied above. Further Nowak discloses the method of (5) storing each beam scheduling sequence in a memory (fig. 2, ref. 38) and (6) retrieving the beam scheduling sequence from the memory to be used for controlling the beamforming circuit during the interval of its use (col. 5, lines 10-16).

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following prior art references not relied upon above are cited to further show the state of the art with respect to beamforming antenna arrays and Nx1 beamforming antenna array switches.

U.S. Pat. No. 5844951 to Proakis et al; MMSE beamforming method

U.S. Pat. No. 5933446 to Bond et al; Adaptive beamformer

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M Perilla whose telephone number is (703) 305-0374. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Chin can be reached on (703) 305-4714. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9314.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 306-0377.

Jason M Perilla

Jason M Perilla
November 18, 2003

jmp

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